Horton [2] concluded, after noting the evaporation of snow in the outer can of the standard raingage, that for fairly cold weather without heavy winds, with air usually clear, the evaporation amounts to about 1 inch of water per month during the winter at Albany, N. Y. This is about twice the average monthly value obtained in Utah by the writer.

Church [3] mentions a single instance of excessive evaporation in Nevada where 0.1 inch of moisture was evaporated in a single night, with an average wind movement of 33 miles per hour, the temperature being below freezing.

Total evaporation, winter of 1915–16.—The figure capable of the most practical application in this work is, of course, the total evaporation for the snow season. This value has been obtained in two ways: *First*, the mean daily evaporation of 0.0175 inch multiplied by the length of the snowy season, 180 days, gives 3.15 inches as the winter evaporation. The *second method* is probably more accurate. For each 10-day period the mean temperature was ascertained, together with the number of hours without precipitation in which it was assumed that evaporation was taking place. Then by means of the curve in figure 2, the total evaporation for the 10-day period was determined. By adding all of these periods together, the total of 2.80 inches was obtained for the winter. It seems evident therefore that under conditions existing at the Utah Experiment Station—and which may hold for all the higher parts of the mountains of Utah—3 inches is a fair figure for the winter evaporation of 1915–16. The water equivalent of the snowfall in the same locality for the winter of 1915–16 was 21.91 inches, so that approximately 14 per cent of the total snowfall was evaporated into the air. In making careful snow surveys in the Great Basin this figure should prove of value, particularly in cases similar to the erosion and stream-flow experiment at the Utah Experiment Station in which the losses by percolation into the soil under different conditions are to be determined.

Effect of forests.—The effect of forest cover on evaporation can hardly be determined from these data since it acts partly through its influence on wind velocity, a matter which could not be investigated in a satisfactory manner on account of drifting and erosion during high winds. The few readings that were secured, however, indicate a considerable increase in evaporation with increased wind velocity, which Church's data also corroborate. Forest cover also reduces the direct insolation upon the snow and probably reduces the evaporation in consequence. If Rolf's formula quoted above is based on sound principles, it appears that insolation would be an important factor in accelerating evaporation, depending chiefly on the rise in temperature of the surface snow. It seems probable, therefore, that forests, by shading and checking the wind movement, diminish the evaporation from the snow cover especially in wind-swept situations; but this may be partially counteracted by the greater area exposed to evaporation by the snow clinging to the branches of the trees, particularly the conifers which form the forests at higher elevations throughout the Rocky Mountains.

DARK DAY IN JAMAICA.

In the MONTHLY WEATHER REVIEW for January, 1917, page 12, Mr. Maxwell Hall, meteorologist to Jamaica, reported an observation of the dark day of May 19, 1780, from Jamaica. The editor there suggested that the observation was perhaps that of the effects of a local or near-by forest fire. Mr. Hall replies that as there are no forest fires in Jamaica, the woods always being too green, the explanation must be sought elsewhere.

[2] *Horton, R. E.* MONTHLY WEATHER REVIEW, 1914, 42: 99.
[3] *Church, J. E., jr.* The progress of the Mount Rose Observatory 1906–1912. Science (N. S.), December 6, 1912, 36: 796.

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DISTANCE AT WHICH THUNDER CAN BE HEARD.

The following observations by Cooperative Observer Clarence E. Miller, at Carlisle, Pa., have been condensed from a report received through Section Director Geo. S. Bliss, meteorologist in charge of the Philadelphia office. They furnish interesting evidence and testify to the painstaking work of the observer. The following note of experiences in other countries is also of interest, and may rouse yet others to similar observations.—EDITOR.

On the evening of June 27, 1913, between 7:30 and about 8:30 o'clock, dense clouds were observed moving north to south far east of Bloserville, Pa., and sharp lightning in the summits of these clouds developed within a few minutes into vivid flashes covering the whole cloud system. Thunder could be heard very faintly after sharp streaks of lightning; and soon there came an almost imperceptible breeze from the east * * *. I then did the best thing I knew of to determine the distance of the lightning: I observed carefully what appeared to be the heaviest streaks of lightning and counted at such a rate that every 5 counts would be equivalent to a mile [traveled by the sound]. Two others with me I had do the same thing to check my counts. We kept this up for 10 minutes or more and were surprised to find that the report of the thunder followed the flash of lightning in from 170 to 175 counts. The time between flash and thunder was almost 3 minutes each time; and the report of the thunder was quite distinct although only the heavy "bump-ump-ump" was heard without a rolling, rumbling sound. This meant the storm was about 30 to 35 miles distant; and inquiries from other observers in Harrisburg developed the fact that this identical storm traveled north to south along a line through Hummelstown and Middletown, where it attained great severity. This storm was therefore actually 30 to 40 miles distant from us while observing it.

On the night of July 1, 1913, at dusk I observed contrasted against the dense, fog-like haze which had opposed the sun's rays for an hour preceding sunset, a lone small cloud of very dark appearance and slowly increasing in size. At dark I observed a flash of lightning in the cloud, followed in a few minutes by another flash, and then by many more in rapid succession, accompanied by heavy thunder. A number of persons were with me, and by counting the interval between lightning and thunder we estimated the storm to be 10 to 12 miles distant. It lasted about half an hour and died out as rapidly as it came up. The sound of the thunder was terrific and I am sure could have been heard at two to three times the distance we were from the storm. Later inquiry showed that this storm was the violent, tornado-like destructive one that visited Carlisle, Pa., and that it was 10 to 12 miles distant. I am certain the thunder carried twice as far.

On the night of August 18, 1913, we observed a storm south-southeast of Bloserville, Pa., in the direction of Gettysburg, with vivid and continuous lightning. Although there was a wind from the northeast [i. e., a cross wind], the thunder could be heard quite plainly at times. The exact location of this storm I have not been able to determine, but we could see plainly that it was not on the northern side [i. e., his side] of South Mountain which was 15 miles away, and the clouds suggested that it was considerably beyond the other side of that ridge. [It was therefore between 16 and 18, perhaps 20, miles distant].

On July 13, 1917 (Friday night), I could hear very distant thunder about 10 p. m. from southeast of Carlisle, Pa., and could see the lightning flashing; but could not see any clouds because of the buildings. About 4 p. m. and later of the same day I had been able to observe dense thunder clouds far to the south-southeast, and later no other clouds appeared where I had seen these; so that the thunder heard at 10 p. m. may have come from the continuation of the same storm. The clouds at 4 p. m. were too far away for me to hear any thunder above the noise of the street traffic, and while the storm must have travelled quite a distance between 4 and 10 p. m., yet if the thunder at 10 p. m. was from the same storm it must have been still very distant. The very light southeast wind at the time was, of course, favorable.

In this connection the following extracts from a relatively recent note in another publication [1] will be of interest to Mr. Miller:

It is rather rarely the case that the flashes in a distant thunderstorm are so spaced that one can tell certainly to which flash a particular peal of thunder belongs: hence the difficulty of testing the [old time] figures. Such an opportunity was, however, presented to a well-known German meteorologist, Dr. R. Henning, while he was visiting a summer resort on the Baltic [Aug. 4–5, 1911, in Zinnowitz]. From his bed one night he observed the flashes of a thunderstorm far out at sea, at intervals of several minutes. The thunder was faint, but distinctly audible. On "counting seconds" he found that from 80 to 90 seconds and upward elapsed between lightning and thunder. The maximum interval was 96 seconds.

Commenting on this observation the editor of the Meteorologische Zeitschrift [Nov. 1911, 28:538] states that in northern Germany intervals of from 80 to 85 seconds between lightning and thunder have frequently been recorded. On the coast, with an abnormal distribution of atmospheric density, much greater intervals are sometimes observed. At Norden, East Friesland, C. Veenema has on several occasions noted intervals as great as 140 seconds. At ordinary temperatures of the air this would correspond to a distance of about 29 miles. In one case this observer believed the interval to have been 310 seconds, representing a distance of about 65 miles.

William Bullock Clark, 1860–1917.

By W. J. HUMPHREYS, Professor of Meteorological Physics.

[Dated: Weather Bureau, Washington, D. C., Aug. 18, 1917.]

[By direction of the Chief of Bureau.]

Dr. William Bullock Clark, professor of geology in the Johns Hopkins University, and director of the State Weather Service of Maryland, died from heart failure on July 27, at North Haven, Me.

Some of Dr. Clark's ancestors were among the earliest colonists. Two of them came to Plymouth, Mass., on the *Mayflower*. He was born at Brattleboro, Vt., December 15, 1860. His education was at the high school of Brattleboro, Amherst College (A.B. 1884, LL.D. 1908), University of Munich (Ph. D. 1887), Berlin, and London.

Dr. Clark's entire professional career, despite numerous offers to go elsewhere, was spent at one institution, the Johns Hopkins University, where he was instructor from 1887 to 1889, associate from 1889 to 1892, associate professor from 1892 to 1894, and professor and head of the department of geology since 1894.

In addition to carrying on numerous investigations of his own, Dr. Clark was even more productive as organizer and director of various public services, such as the Maryland State Weather Service; the Maryland Geological Survey; the Maryland State Board of Forestry; and many others. A brief outline of the purposes and results of the first of these will, perhaps, suffice to indicate the usual thoroughness of his plans and tenacity of his purposes.

This service, the Maryland State Weather Service, was organized May 1, 1891, under the joint auspices of the Johns Hopkins University, the Maryland Agricultural College, and the U. S. Weather Bureau, with Dr. Clark as Director, a position he held continuously until his death, more than 26 years later.

In a letter to the governor of Maryland, dated July 1, 1899, transmitting the first volume of a new series of reports, Dr. Clark says:

The Board of Control plan to publish in the near future a full account of the climatic features of Maryland, in which the physiography, the meteorology, the hydrography, the medical climatology, the agricultural soils, the forestry, the crop conditions, and the flora and fauna of the State will be considered.

The last report, dated January, 1916, says:

The State Weather Service in addition to the publication of many earlier reports has issued three large comprehensive volumes as follows:

Volume One deals (1) with the Physiography of the State, in which the character of the lowlands and the highlands, the drainage channels and the shore lines of the estuaries, bays and ocean front are described as a basis of climatic differentiation, and (2) with the Meteorology of the State, in which the different factors relating to rainfall and temperature throughout the State are discussed in much detail. This latter report is accompanied by a series of maps showing graphically the distribution of rainfall and temperature for each month of the year.

Volume Two deals with the Weather and Climate of Baltimore and is a very exhaustive study of all available records relating to the meteorology and climatology of the chief center of population in the State. It represents the most comprehensive investigation that has ever been given to any municipality in the country.

Volume Three deals with the Plant Life of Maryland in its relation to climatic factors. The distribution of plant life, or ecology, is fully discussed; also crop distribution, since this is dependent likewise on climatic factors. Several well-known experts were employed in this study and the volume is recognized as possessing much practical as well as scientific value.

The Service is now engaged in a detailed study of the climatic features of the several counties. * * *

The Service is also engaged in a quantitative study of the results of climatic factors upon vegetation, this work being conducted under the direction of Prof. B. E. Livingston of the Johns Hopkins University. By growing various cultivated plants at different stations throughout the State under similar soil conditions and keeping a careful quantitative record of their growth, changes and physiological activity it is expected that accurate data will be obtained showing the results of the varying climatic conditions in crop production.

This indeed is a remarkable showing. In the death of Dr. Clark, meteorology and climatology have lost a most efficient promotor, geology one of its ablest exponents, and the public a most capable and devoted servant.

WILLIAM BULLOCK CLARK.

In another place the bureau comments officially on the passing of Prof. W. B. Clark, founder and first director of the Maryland State Weather Service.

Five years of association with Dr. Clark inspired in the present writer a sincere regard for him as a man and a friend. To his associates and the students in his department Dr. Clark was not merely a teacher but a brother and a friend, always ready to recognize and encourage the slightest show of enterprise, effort, or ability; always cheering and heartening all about him and unconsciously offering his own great store of energy and enthusiasm as a stimulus to even the humblest of his associates. In the field Clark was the best companion one could desire, full of work and full of humor, a splendid planner of excursions and expeditions, a no less successful executive in carrying them to a pleasant and profitable close.

While primarily devoted to Geology and Palæontology, and making a brilliant mark for himself in the latter branch, he developed abundant enthusiasm for helpful work in other branches of science. The series of splen-

[1] Scientific American, New York, Jan. 20, 1912, 106:77.